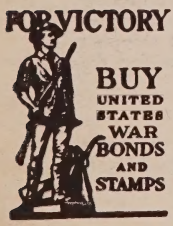
Vol. 9 SEPTEMBER, 1944 No. 9

CORNELL-DUBILIER ELECTRIC CORP.
HAMILTON BOULEVARD
SOUTH PLAINFIELD, N. J.



WANTED: Signal Corps Equipment

You may have Radio-Amateur and Photographic equipment that is urgently needed by the Army Signal Corps. The Army will buy the following from private individuals.

Radio: Standard and commercial built short wave transmitters (such as Hallicrafters HT-1, etc.; Temco and Collins Model 32 and 30) and Standard and commercial built short wave receivers (such as Hallicrafter, National, RCA, RME, Hammarlund or Howard); AC and DC Voltmeters, Ammeters, Milliammeters, Radio Frequency Meters and Volt-ohm, milliammeters; Oscilloscopes, 2-3 inch; Audio sig. gen. 30-15,000 cycles; RF sig. gen. 15-215 megacycles; late model Tube Checkers. and other test equipment.

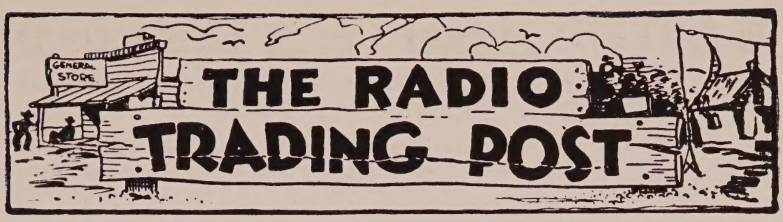
Photographic: 35 MM Motion Picture Cameras (such as Mitchell (all models), Bell & Howell - Standard Professional, Akeley-Professional (all models) and Eyemo (all models) Bell & Howell Mfg.), etc., and 16 MM Motion Picture Cameras (such as Cine-Kodak Special, Magazine Cine-Kodak, Filmo 70.D or Filmo Auto Master); Tripods; Lenses, all types for 35mm and 16mm equipment; Exposure Meters; and Cameras (such as Speed Graphic 4" x 5", and Speed Graphic 2¼" x 3¼" with or without flash synchronizers) and Leica Model III (F) or 11B (C), or equal; Range Finders; Pack Adaptors and Cut Film Holders.

If you have this type of equipment, you can assist the war effort materially by selling it to the Army. Write to:

EMERGENCY RELIEF SECTION
PHILADELPHIA SIGNAL CORPS PROCUREMENT DISTRICT
5000 WISSAHICKON AVENUE, PHILADELPHIA, PA.

briefly describing the equipment you have and stating the price at which you can offer each item. FOB Philadelphia. Do not ship any material without specific directions from that office.

Price consideration is based upon your net cost less reasonable depreciation for use, age, and condition of equipment. Inasmuch as all equipment is being purchased FOB Philadelphia, cost of packing and shipping can be shown separately so that an allowance for the costs can be made when material is accepted.



A Free Market-Place for Buyers, Sellers, and Swappers.

These advertisements are listed FREE of charge to C-D readers so if there is anything you would like to buy or sell; if you wish to obtain a position or if you have a position to offer to C-D readers, just send in your ad.

These columns are open only to those who have a legitimate, WANTED, SELL or SWAP proposition to offer. The Cornell-Dubilier Electric Corp. reserves the right to edit advertisements submitted, and to refuse to run any which may be considered unsuitable. We shall endeavor to restrict the ads to legitimate offers but cannot assume any responsibility for the transactions involved.

Please limit your ad to a maximum of 40 words, including name and address. Advertisements will be run as promptly as space limitations permit.

WANTED—Latest NRI course in good condition, also test equipment, such as V OM or combination set testers and tube tester. Cash at once for good equipment. Charles Lentz, 2300 Bronx Park East, Bronx 67, New York, N. Y.

FOR SALE—1 dc generator 6 or 12 vdc to 350 to 700 vdc, on 6 volts delivers 350, 12 volts, 700 dc, just overhauled, new bearings and brushes installed. Make offer, S. Wiseman, 114 N. Elmwood Ave., Buffalo 1, New York.

FOR SALE OR TRADE—4 12" frequency Recodes; 0-1 voltmeter. WANTED—Radio testers or photo enlargers, or cameras. Milt Farber, 454 Ocean Ave., Jersey City 5, N. J.

FOR SALE—1 3Q5GT, 2 1Q5GT, 2 1H4G, 2 1N5GT, 1 6N5, 1 heavy duty power transformer for car radio, 10 asst. bypass condensers, new. 1 31, 1 A4 tubes used. First money order for $12.50 for all. Delbert Shaffner, Deepwater, Mo.

WANTED—Complete instructions for Million tube checker, model DF, either copy or photostat. Will pay any reasonable price. Paul Sibre, 2733 S. W. 11 St., Miami 35, Florida.

FOR SALE—Precision 700 Electronometer (comb. tube and set tester), Solar CB 1-60 condenzer analyzer, 110 v. ac-dc 2-speed record player portable with ac-dc amplifier, also asst. radio tubes, parts, used auto radios. All inquiries answered. Raymond M. Zwickel, 1660 E. 13 Street, Brooklyn 29, N. Y.

FOR SALE — Hickok 53X dynamic tube tester. Hickok all wave signal generator with built-in out-put meter. Webster 60 watt amplifier with all tubes. Walter Kryger, 912 W. 151 Street, East Chicago, Ind.

FOR SALE—Supreme No. 546 oscilloscope (3" very new); No. 582-A Sig. Gen. and Mod. (new condition all bands); No. 550 set analyzer (36 ranges incl. cond. test). Have factory instructions for all, reasonable. T. D'ddario, 13545—117 St., Ozone Park, N. Y.

WANTED—Test equipment to be used for radio repair shop: VOM, signal generator and tube tester. Marvin Cohen, 1045 Maryland Ave., Atlantic City, N. J.

WANTED—Cathode ray oscilloscope or 3" or 5" cathode ray tube. W. L. Thiel, 96 Westbury Blvd., Hempstead, N. Y.

FOR SALE—2 Zenith chassis and speakers, 1 General Electric Model K32 chassis and spkr., other sets. Louis A. Goldstone, 1279 Sheridan Ave., Bronx 56, New York.

RADIO TUBES FOR SALE — Get my list price. Last stock of tubes were sold out in one day. New shipment arrived. V. Kozma, 3104 Wilkinson Ave., New York 61, N. Y.

TRADE — Savage .22 Hi-power repeating rifle for late issue of Sprayberry radio course. Want Templetone sheet from Vol. I of Rider's Manuals. L. C. Chapman, Rt. 1, Columbus, Miss.

FOR SALE—Hearing Aid $10; Dayrad tube tester to 48 volts, $3.00; complete Philco auto radio $5.00. Tauber's Radio, 516 South Cicero Ave., Chicago 44, Ill.

TRADE 2 12" auditorium type ac dynamics, need new cones, have line matching transformers, will trade for 12SA7 tubes. Can use 35L6 and 50L6. United Radio and Sound Service, 71 12th St., Wheeling, W. Va.

FOR TRADE OR SALE—Transmitting and receiving tubes, several meters, receiver and H.V. power supply parts, quartz crystals, 16mm movie equipment, other radio equipment, chemicals and lab. equipment. Write for list. A. Zambakian, 1259 Gaylord St., Denver 6, Colo.

WANTED—Late model tube tester, multimeter, and a set of Rider's Manuals. Walter Lyons, Darien, Ga.

TUBES FOR SALE—Most any type, no order accepted for less than 10 tubes, OPA list on all tubes, send check or money order. Refund on any types we happen to be out of. Levenson, Suite 6, 7 Monroe St., Mt. Vernon, N. Y.

FOR SALE—New Neo-Glo automatic electric Radio Service sign. Send $2.00 full price, pay shipping on delivery. Also want a small radio, whether playing or not. Have Sunbeam shaver, like new. Make offer. M. Levengood, Palmyra, Penna.

WANTED—For cash or trade, power transformer of 110v input of 200 or 250 ma. with 6.3 volt winding, also filter choke of 200 or 250 ma. Want 35mm candid camera. Have 2 band 6 tube radio with magic eye tuning, from 5 mc to 550 kc, works off one 6v battery, new tubes, A1 shape. John Arnold, P. O. Box 84, Bluffs, Ill.

FOR SALE OR TRADE—Italian P. Beretta pistol, .38 cal, with holster and 40 bullets. Gun taken from Italian officer during invasion of Sicily. Also Supreme model 85 tube tester, Philco signal generator. Wanted: RCA Voltohmyst, Jr., small electric drill, small radios, tubes, and any test equipment. W. S. Frank, Chippewa Falls, R. R. 3, Wis.

WANTED FOR CASH—Small radios, vacuum cleaners, test equipment, record players, cameras. G. Samkofsky, 527 Bedford Ave., Brooklyn, N. Y.

FOR SALE—Hearing aid, complete with mike and earphone. Best offer takes. R CA 3 tube, 8 button Inter-com. system. Best offer takes. Tauber's Radio Shop, 516 S. Cicero Ave., Chicago 44, Ill.

TRADE one used 913 cathode ray tube for phono pickup, prefer audox. William Macnes, 154 Woodland, Campbell, Ohio.

FOR SALE — Have ultra-high equipment tubes, wireless phonograph, etc. Want 8 mm movie projector, home recorder, crystal mike, vibra-pack. W. M. McDonald, 933 Main St., Melrose 76, Mass.

SWAP—Simpson 0-200 ma dc meter in A1 shape plus cash for an 0-1 ma dc meter of reliable make and in similar condition. W. E. Percel, 2315 Caledonia St., Toledo 5, Ohio.

FOR SALE—Maytag two cyl. gas engine, 32 v. Philco cabinet radio also others, 2 late model battery farm radios. WANTED—Medalist Kodak camera, Junior Voltohmist RCA, Ampso 16mm sound projector, model X or XA. F. Miller, 208 Linden Ave., Woodlynne, N. J.

WANTED—Late model signal generator in good condition. Write Auburn Radio Service, 829 Park Ave., Cranston 10, R. I.

FOR SALE—Tubes and parts. Supreme Diagometer, Supreme sig. gen., VTVM tube tester, other tester, new phono motor ang table. Cash only or sell whole shop. Crooks Radio Service, Box 94, Kent, Ohio.

WANTED—Modern tube checker; also a late model signal generator. Write stating make, condition and price to Harry's Radio, 7 School St., Glen Cove, L. I., N. Y.

WANTED—Reel for lake fishing—Pfleuger or Shakespeare preferred, or any good make—must be in good condition. Cash. Bert Buckner, 280 W. Central, St. Paul 3, Minn.

FOR SALE—Home built volt OHM meter. Jewell 135 foundation meter—ten dollars cash. Oscar's Radio Service, Merrill, Iowa.

SALE OR TRADE — Teleplex Jr. Code mach. with five tapes and built in AC oscillator, new Triplett 221 0-10v DC VM. WANT "Kirsten Pipe" recorder, two speed, Pvt. J. C. Terribilini, Signal Co. SCU 1991, Presidio of San Francisco, San Francisco, Calif.

FOR SALE — Model 85 Supreme tube checker with adapters, $20; Thordarson output trans. T15S92, new, $18; Thordarson driver trans. T15D85, new, $9.60. Thordarson choke T75C51, new, $6; Rider's manuals 1 & 3, ea. $5; Electric Service sign, $3. Clair E. Breth, Sr., 213 S. 4th St., Youngwood, Pa.

(Continued on page 11)

SERVICING L. F. AMPLIFIERS*

Fundamentals of Audio Amplifier Stages. Frequency Response Characteristics and Gain Calculations

Low frequency amplifiers are designed to increase small voltages in the audible frequency range of approximately 16 to 18,000 cycles per second, obtained from microphones, electric phonograph pickups, the detector stage of a radio receiver, and other devices. In communication work these low frequency amplifiers are called audio amplifiers and these two terms will be used interchangeably. The amplified voltage is usually applied to a loudspeaker or other device to convert electrical energy into mechanical energy.

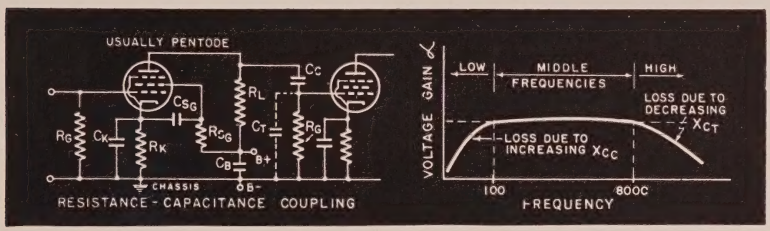


Fig. 1. Typical resistance-capacitance coupled amplifier showing frequency response and effect of circuit components. C_T is stray wiring and Miller effect capacitances.

Low frequency amplifiers usually must be capable of uniform gain over all or some portion of the 16-18,000 cycle band. The uniformity of gain with frequency is primarily a function of the type of coupling between the stages of tubes.

One essential detail that must be accomplished by any system used in coupling the output of one tube to the input of another is that of preventing the direct plate voltage of one tube from disturbing the grid bias of the next tube, and yet it must pass the signal current with a minimum of modification of amplitude and phase as the frequency changes. The positive plate voltage on the first tube, possibly several hundred volts, must not be applied to the successive grid which is essentially negative, both being measured with respect to the B— or "ground."

Audio stage coupling systems include iron core transformers, resistor-capacitor combinations, and inductor-capacitor combinations. All of these will ordinarily produce frequency distortion of the signal to some degree. It is necessary to study each problem as to the best coupling method to use.

The conditions for perfect transfer of signal current from one stage to the next are: Faithful reproduction of all frequencies present in the

* *Courtesy of Radio and Television Retailing.*

original signal, without altering the wave shape; Magnification of the amplitude of the signal in a linear manner. The principal types of audio coupling methods and their general frequency response characteristics are shown in Fig. 1, Fig. 3, and Fig. 4.

In some problems, there is a need not only to amplify the signal but to modify it in some pre-arranged manner, giving another problem to the design of vacuum tube amplifiers.

R-C Coupled Voltage Amplifier

The use of tetrodes and pentodes is a practical means for getting a simple voltage amplifier at lower cost and weight, and under usual conditions, with less frequency distortion, than those using transformers for coupling. A typical circuit in Fig. 1 shows a capacitor for coupling the plate of one tube to the grid of the next, and high-value resistors for plate and grid circuits. The coupling capacitor, C_c, is sometimes called a blocking capacitor since it offers a very high impedance to D.C. This coupling system is often designated simply resistance coupling.

Since the alternating voltage must appear across the following grid resistor R_G, there is provided a coupling capacitor C_c which offers low impedance to signal current through the grid resistor R_G. The following tube also has an input capacitance which is in shunt with its own grid resistor. This input capacitance, C_T, is a parallel combination of the inter-electrode grid-cathode capacitance and the Miller effect capacitance. Thus the effective load on the first tube consists of a combination of the tube's own internal plate resistance R_p, the plate load resistor R_L, the grid resistor R_g, the coupling capacitor C_c and the next tube's input capacitance C_T. The equivalent circuit is shown in Fig. 2.

The voltage gain of a resistance-capacitance coupled amplifier stage is never equal to the "μ" or amplification constant of the tube. The plate-circuit alternating voltage is divided between two impedances in series. One of these is the plate resistance,

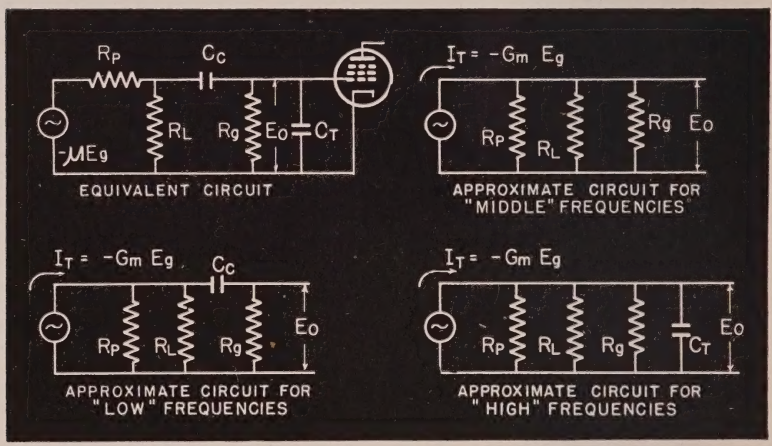


Fig. 2. Equivalent circuits for resistance coupled amplifiers at middle, low and high frequencies showing active components.

R_p, of the tube itself. The other is the combination of the load resistance R_L, the grid resistor R_G, the coupling capacitor C_c, and shunt capacitor C_T.

At medium and low audio frequencies the tube's input capacitance C_T is not important, since its reactance is usually greater than R_G, while C_c can readily be chosen of such a size that the voltage drop through it is small. The load is then nearly pure resistive and the gain calculation becomes:

$$\propto = \text{Voltage gain} = \frac{G_m}{G_p + G_L + G_g}$$

Where G_m is the mutual conductance of the tube in mhos (this value is usually listed in micromhas which is 10^{-6} mho.), G_p is the tube's plate conductance $(1/R_p)$, G_L is the conductance of the plate-load resistor $(1/R_L)$, G_g is the conductance of the grid resistor $(1/R_G)$.

At low audio frequencies (say below 100 cycles) the reactance of the coupling capacitor C_c begins to cause a considerable voltage drop, since it is in series with R_G. The equivalent circuit is shown in Fig. 2. For example at 60 cycles, with a coupling capacitor of 0.011 μf and a grid resistor of one-half megohm only 90% of the voltage is effective between grid and cathode. If the same percentage is to apply at 30 cycles, C_c must have twice the capacitance. It is not desirable to increase C_c much beyond the actual low frequency response requirement for three reasons, (1) the amplifier stability becomes less, (2) a physically larger capacitor increases "hum" and noise pickup and (3) the leakage of DC to the grid increases. However, if several stages are to be used it may be necessary to go farther in the matter of securing "flatness" in the frequency response curve since the deficiencies of the stages are multiplied by cascading. Thus if a stage gain drops 20% at 60 cycles (response 0.8) then three such stages will respond $(0.8^3) = 51\%$ of middle frequency gain.

The gain at low frequencies is calculated by the process of applying correction factors to the gain calculated for the medium frequencies. These factors may be found in a number of standard texts.*

At high frequencies C_c may be ignored because of the decreasing reactance but C_T assumes increasing importance and eventually becomes the dominant factor so that a plain resistance-coupled amplifier gives little gain above approximately 50,000 cycles. The lower gain is due to the decreasing reactance of the input capacitor C_T which is shunted across R_G. The equivalent circuit is shown in Fig. 2. For any tube, the input capacitance does not have only the small value listed as the grid-cathode capacitance but instead:

$$\text{Input } C_T = G_{gk} + C_{gp}\ (1 + \propto)$$

For a typical amplifier using a 6F5 high μ triode,

$$\text{Input } C_T = 5.5 + 2.3\ \ (1 + 70) = 160\ \mu\mu\text{f (maximum)}.$$

While tetrodes and pentodes have C_{gp} values of about 1/1000 that of similar sized triodes, the stage gain $\propto$ is greater also. In general the total input capacitance C_T will be lower than for triodes.

The gain of the resistance-capacitance amplifier is less at low frequencies (under 200 cycles) and at high frequencies (over about 8,000 cycles) than at middle frequencies (1,000 to 4,000 cycles).

The voltage gain of an amplifier stage is best shown by example. The problem is to determine the amplification of a 6J7 pentode with resistance-capacitance coupling. The tube's G_m = 1,200 micromhos, plate resistance R_p = 1 megohm, (these are found from a tube data book). The coupling device consists of a plate-load resistor R_L = 250,000 ohms, a grid resistor of 500,000 ohms and a coupling capacitor of 0.01 μf.

*The Electronic Engineering Handbook—Caldwell-Clements.
Radio Engineering—McGraw-Hill.

The next step in using equation (1) is to determine the corresponding conductance. The plate resistance of 1,000,000 ohms (10^6) has a conductance of $1/10^6$ or 10^{-6} mhos. The plate-load resistor value of 250,000 ohms gives 1/250,000 or 4×10^{-6} mhos and the one-half megohm resistor R_g, a conductance of 1/500,000 or 2×10^{-6} mho. These conductances are in parallel (see Fig. 2) hence adding them gives the total conductance of 7×10^{-6} mho. To find the

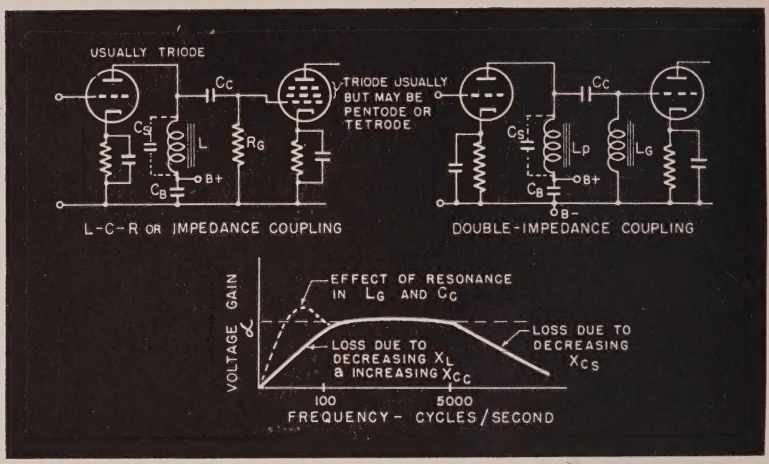


Fig. 3. Impedance coupling gives frequency response similar to resistance coupling except where grid choke is used. Resonance in C_C and L_G give low frequency rise in amplification. Rise may be controlled by shunting resistor across L_G.

middle-frequency voltage gain it is now only necessary to divide the tube trans-conductance (G_m = 1200 micro-mhos = 1200×10^{-6} mhos) by the sum of the circuit conductance (7×10^{-6} mhos).

$$\alpha = \frac{1200 \times 10^{-6} \text{ mhos}}{7 \times 10^{-6} \text{ mhos}} = 171$$

Impedance-coupled Amplifier

An obvious way to avoid the direct voltage drops in the resistors of an R-C coupled amplifier is to replace them by iron-cored inductors. Usually only the plate resistor is so replaced and the arrangement may be called an impedance-capacitance-resistance coupling or simply an impedance coupling. The frequency response is inferior to that of resistance-coupled amplifiers. Typical circuits and response curves are shown in Fig. 3. The decrease in gain at high frequencies is greater because chokes have more distributed shunt capacitance than resistors. The decrease in gain at low frequencies is greater because the inductive reactance falls with frequency while resistance does not. The arrangement is used less since tubes suited to resistance coupling have become available. Impedance coupling is used primarily with triodes where the relatively high plate current makes the use of load resistors costly since a large power supply voltage would be required.

If both plate and grid resistors are replaced by chokes, "double impe-

dance" coupling results as shown in Fig. 3. Since two chokes are then in parallel (for AC) the high frequency decrease is accentuated but a low-frequency rise can be produced by choosing the two chokes and the coupling capacitor to produce series resonance at the low end of the desired range. A desirable type of low frequency rise results if the coils are chosen so that their Q is between 1 and 2 at the resonant frequency. The gain at the resonant frequency over and above the ordinary middle frequency gain of the stage is about

design principles. A typical transformer coupled amplifier is shown in Fig. 4.

Using a well-designed transformer for the medium frequency range the Class A gain of a transformer-coupled stage is nearly:

$$\text{gain} \propto = \mu \frac{(\text{sec. turns})}{(\text{primary turns})} -$$

i.e., the tube gain multiplied by the transformer gain. It is correct only if the primary reactance is large as compared to its resistance and to the plate resistance of the tube. Conse-

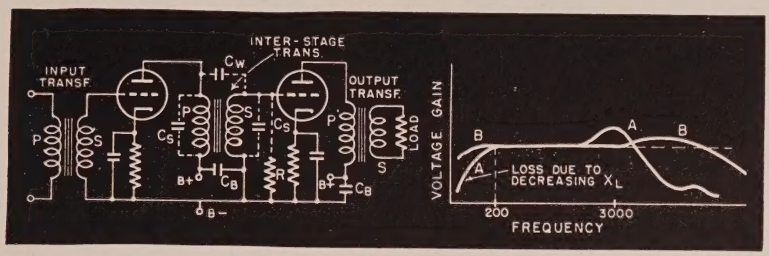


Fig. 4. Transformer coupling showing stray inter-winding capacitances. Curve A is typical of cheap transformer while B is for high grade type.

1 DB for Q = 1; 3 DB for Q = 1.4; and 6 DB for Q = 2. It is necessary that the plate-circuit coil have a reactance 3 or 4 times as great as the plate resistance for good response.

Transformer Coupling

There are several advantages in audio transformer coupling. There is a negligible drop in plate supply voltage through the transformer windings, hence the "B" supply voltage may be moderate. The DC grid circuit resistance can be very small where an input transformer is used. This is an advantage with certain classes of power amplifier operation, particularly Class B. Since such coupling devices can be purchased ready-made the frequency response in considerable part depends upon the observation of general transformer

quently equation (3) holds true for medium frequencies but fails at low frequencies because the transformer's primary reactance falls. The decrease in amplification is related to the resistances just mentioned, and the transformer's low frequency response curve can be predicted if there is known: the tube's plate resistance (tube data book) and the resistance (R_1) of the transformer primary, and its inductance (L) with the secondary open such as might be measured on a bridge. It is to be noted in Fig. 5 that the effect is most pronounced in a transformer (Curve 1) whose secondary is unloaded, or connects to an extremely high resistance such as a Class A grid circuit. If the load resistance (as R in Fig. 4) equals the source resistance, R_p + primary R_1, (Curve 2) the low fre-

quency loss is less. Finally with a load whose resistance is much less than that of the source (Curve 3) the low frequency loss is small. This is observed in a practical way in the relative small size and cheapness of Class A output transformers feeding

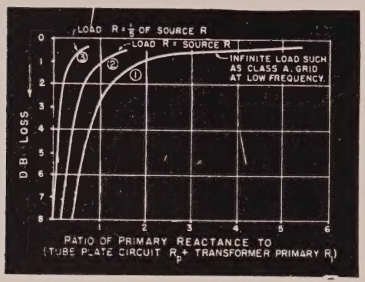


Fig. 5. Low frequency response characteristics of transformer for various plate loads.

low impedance loads. Conversely, if two transformers be equally well designed, one as a "plate-to-grid" transformer, shown as solid curves C and D of Fig. 6, it will produce a curve dropping off more at the low end than the corresponding "plate-to-line" or "line-to-line" transformers shown by the dashed curves in Fig. 6.

This situation is aggravated if the transformer is made too small, as in the case of the curves for a cheap example, Fig. 6, Curve A. Occasionally this kind of thing is done deliberately to create a transformer which is peaked at some particular frequency that must be amplified. Curve B, Fig. 6, is for a transformer exactly like that with Curve A except that a trifle over one-half of the primary has been removed, the primary reactance thus dropping to about one-fifth of its former value. Lack of amplification at low frequencies is now very apparent. The transformer becomes a very poor load for the tube except for that frequency to which it is tuned by its own inductance and the capacitances in the circuit and that of the transformer itself.

The high frequency drooping of the gain curve is due to the shunting effect of the capacitances within the transformer and in the circuit. The user of the transformer can do very little about this, but the maker of the transformer can (and usually does in the case of high grade transformers). Thus in the solid curve C of Fig. 6, for the high-quality broadcast service transformer there is a resonance peak at 10,000 cycles, produced by tuning the transformer inductance with the capacitance of transformer and circuit to 10,000 cycles. Here the leakage inductance is referred to, obtained by measuring the primary's inductance on a bridge with its secondary short-circuited. That this is the actual cause is shown by the dashed curve in C for a similar transformer working into 500 ohms. The

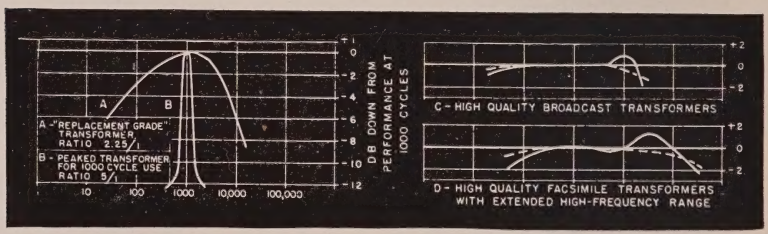


Fig. 6. Response characteristics of several types of audio coupling transformers. Design of unit is major factor in high fidelity equipment.

10,000 cycle rise by resonance, cannot take place with only a 500 ohm load. Similarly the solid curve D shows a resonance which has been moved out to 30,000 cycles by diminishing both the capacitance and the inductance of the transformer secondary. In the absence of this high frequency "bump" the curve simply droops in the permanent manner of the dashed curves.

THE RADIO TRADING POST

(*Continued from page 4*)

URGENTLY NEEDED — By service man SX28 Hallicrafter. Send price and details to Pvt. J. Leonard King 970812, 2nd Trng. Bn., Co. B., Inf. Trng. Regt T.C.-F.M.F., Camp Pendleton, U.S.M.C., Oceanside, Calif.

WILL TRADE— Model 582 Supreme signal generator for a late model Royal or Corona portable typewriter in good condition. Rural Radio Service, Clark Lake, Mich.

WANTED—For cash or trade—Jensen JAP-60 or JHP-52 speaker unit. Have large quantity P. A. equipment incl. large Jensen speaker units. Write for list. Also have good used Precision model 500 Electronometer for sale. Kenneth Law, 312 West Third St., Fairmount, Ind.

FOR SALE—Philco auto radio model AR75 with instrument board speaker, $50. Also tested used tubes, 60% off. 00A, 01A, 24, 26, 27, 37, 38, 50, 58, 81, 71A, 6A3, 6L6, 6N7, 6Q7, 99. Add postage. H. R. Ringold, 132 N. Doheny Dr., Beverly Hills, Calif.

FOR SALE OR TRADE—1 to 4 vols of Official Service Manual, good condition, $12. 5, 6 Rider's, like new, $12. WANT good VOM meter or analyzer and 0-1 mil. 3" Bedee meter, state price. V. D. Walker, 716 North St., Pittsfield, Mass.

WANTED—New or used Emerson or other make camera type portable radio in good condition. State Price. Frank A. Witkowski, 32 Daymond St., Trenton 10, N. J.

FOR SALE—6v tubeless vibrack. 100 .22 long cartridges. headphones, 100 used fixed resistors, Jacobs chuck 1/8 to 5/8, ac-dc jig saw, new tubes, 26, 57, 2B7, 79, BH, 10 mixed i.f. trans., 3 mercury switches, single button mike trans., 6v relay, 20-0-20 DC ampere meter. All $38. Radiotrician, 2748 Meade St., Detroit 12, Mich.

FOR SALE—Complete Jr. Mobile Television unit consisting of Iconoscope, relay monitor and 2 receivers with power supply, Cathode Ray tube and shielded cable, quick-set Television camera tripod. Best offer takes it. Samuel M. Mack, 141 Summer St., Lowell, Mass.

SELL OR SWAP—Simpson 333 tube checker in excellent condition, neon short checker, Bosch car radio, $92.55 worth of tubes. All for $85 or will swap for communications receiver, Hallicrafters preferred. Don Flaig, 3806 John St., Fort Wayne 5, Ind.

WANTED—Record player, wireless type. State condition and price. Tom Dugan, 163 Nichols Ave., Syracuse 6, N. Y.

FOR SALE—Six pieces radio testing equipment, $200. 135 new tubes (mixed numbers), quantity new parts, manuals, $250. No split up. Cash or trade for what? W. S. Crooks, Box 94, Kent, Ohio.

WANTED — Signal generator, Clough Bringle OC or OCX and tube and set testers, Supreme 599 or Radio City product 802A. Floyd Morris, Appomattox, Va.

FOR SALE—2 giant Racon Electrodynamic horn units, 5 Master Electrodynamic units all with good diaphragms, sell all for $100. Daidone Radio Service Laboratories, 762-4-6 South Orange Ave., Newark, N. J.

WANTED—Batt. charger, 3 or 10 amp. bulb type preferred. Others considered. State size and price. Clarence W. Hull, Mineral Springs, Pa.

FOR SALE — Webster DeLuxe record changer, changes 16 records, 3 post streamlined loz. permanent pickup, last model made, like new, $95. Meissner 8 tube F.M. tuner, little used, $48. Brand new Astatic model 30Y mike, $25. M. A. Porter, 1713 Larrabee St., Chicago 14, Ill.

FOR SALE—Western Electric model 18 receiver, 30 to 40 megacycles. 110v AC or 6v dc 7 tubes superhet with squelch. A-1 condition. James Lawless, 496 Pleasant Valley Pkwy, Providence 8, R. I.

WANTED—Ampro or Bell & Howell movie projector 16 mm. sound. Must be in working condition. Cash paid. Send for inspection now. WILL SELL—New stock 10w resistors, condensers, volume controls, 1w resistors, other parts all new for $225. Send M.O. Anchor Supply Service, Box 482, Ithaca, N. Y.

WANTED—900-0900v 500ma plate trans., 400-0-400 (450v) 300ma plate trans., 5-20 500 ma Swinging choke, 300 ma swinging choke. Frank W. Jones, Gabbs, Nev.

FOR SALE OR TRADE—Parts of every description. Write for list. Carl A. McKay, 2315 Springfield Avenue, Fort Wayne, Ind.

FOR SALE — GE reactor, 13 henries, 600 mils, 220 v. Two type 601 GE transf., pri. 100-200 v., sec. 15/12 and 7.5/6 v. American transf. 1.5 KVA, pri. 110-220, sec. 1100/2200 v. All 60 cycles. Cheap. M. J. Nederostek, 848 Walnut St., Allentown, Pa.

FOR SALE—New tubes, list price less 40% Nos. 58, 6c6, 78, 56, 38, 12Z3, 77, 6B7, 31, 6D6, 2A6, 76, 2A5, 35, 0Z4, 39, 89, 1T4, 7H7, 7C7, 7E7, 12B8. Mostly 1 to 6 of a kind. K. Petitt Radio Service, Thebes, Illinois.

FOR SALE—1 Racon 4.5 horn, 2 Racon horns with 12 in. cones, 2 Atlas horns for 12 in. cones, Aerovox 75 bridge, Supreme 550 tester, Oxy-acetylene welding outfit. Leo L. Bowman, 615 W. Main St., Lewistown, Montana.

WANTED—Superior Dynarometer with 8½ in. meter made in 1940. Also Superior model 1240 tube tester and model 1230 signal generator. A. J. Talbot, 2334 First Ave. N.E., Atlanta, Georgia.

FOR SALE—Weston meters, model 301, 476 ac, Superior Dynarometer, 1260 mod., Philco recording arm com. with train mod. HR2, Superior channel analyzer, Meisner Television with FM sound. Four bands complete, less cabinet, A1 condition. NEED C-D Capacitor Analyzer BF-50. Cherrill Radio Electric, 4235 E. Barnett St., Philadelphia 35, Pa.

FOR SALE — Stromberg-Carlson model 69 all wave selector, 3 bands, 1430-4200 kc, 3.7-10.5 mc and 9-25 mc, including 6D6, 6A7, 76 and 84 tubes, $15.00 f.o.b. St. Louis. Adolph Hoefer, 21 Lee Ave., Clayton 5, Mo.

FOR SALE—Tubes, 1A7G, 1N5G, 1H5G, 1C5G, 12SA7, 12SQ7, 35Z5, 35A5, 45, 6F6, 6K6G and many other scarce ones. WANTED—Good 8mm movie camera and projector, condenser tester, signal generator, RCP 446 multimeter and good analyzer. Will pay cash or trade. J. M. Fraser, Binscarth, Manitoba, Canada.

WILL TRADE—Small model makers metal lathe with independent chuck, faceplate and drill attachment like new; for outboard motor in good condition. Or will pay cash. All letters answered. V. D. Telschow, 205 So W 1st St., Red Oak, Iowa.

FOR SALE—Business interests, radio and appliance franchises, including equipment, stock of accessories and tubes. Ideal location for money maker and future for right man, who wants to make good. Same location 17 years. Get ready for postwar business. Paul Applegate, Ansonia, Ohio.

TUBES FOR SALE—Price 50c each, 71A, 35, 26, 24A, 27, 80, 37, 38, 39, 55, 57, 58, 33, 6E7, 6B7, 199, 89, 31, 200A, 201A, 2A7, 2B7, 2A5. All are OK, mostly brand new. Hundreds of burned out tubes 5c each. Millhurst Radio Service, Freehold, N. J.

FOR SALE—1SA6GT, 1SB6GT tubes. Also do you need 12, 25, 35 and 50 volt. If so send 50c for details on how repair those burned out ones with your present tube tester. L. M. Wycoff, Box 133, Marmaduke, Ark.

FOR SALE—No. 800 Segal key cutting machine, only needs a new cutter. WILL TRADE Jewell model 540 tube tester, in case, A-1 shape for condenser tester. Highest offer takes either one. Apex Radio and Electrical Shop, 4228 Greenwood Ave., Chicago, Ill.

FOR SALE—1 RCA Rider Chanalyst like new, used few hours $107.50; DuMont 164 3" oscillograph never used, $65.00; 1 slightly used 2 speed turntable with fine crystal pickup, gear driven motor, $50. V. F. Daidone, 762-6 South Orange Avenue, Newark, N J.

SELL OR EXCHANGE—Parts, radios, guns, locks, sewing machines, keys. Shoe repair materials. Walnut, woods, minerals, violin, handmade knives. Tools, screws, bolts. Hobby goods. Geneva Tolley, 217 East Broadway, Clayton, New Mexico.

WILL SELL—Custom-built 2½ meter transceiver having 6J5GTX, 6J5GT, 6L6, 5W4, Federal anti-capacity switch, Thordarson transformers, milliammeter, handwheel dials, nameplates, chrome trim cabinet, ac operation, sell for cost of parts, $25. New Shure crystal handy desk mike, $6.50, DeJur Critic exposure meter for stills, $17.50. L. F. Carini, 246 Wolcott Hill Rd., Wethersfield, Ct.

URGENTLY NEEDED — 12SA7 and 35L6 tubes, will pay full list price OPA, any amount one to 25, have many sets belonging to service men needing these tubes. United Radio & Sound Service, 71 - 12th St., Wheeling, W. Va.

WANTED—All kinds of radio tubes for a fair price, please send list of quantity and price. Radio Maintenance Service Co., 841 South Vermont Ave., Los Angeles, Calif.

FOR SALE—One each Precision 700 and 900 portable set and tube testers, Solar CB-1-60 condenser analyzer, Dumont 164 oscilloscope, Radiart P6 vibrator tester, Precision E 300 signal generator, 110 v. ac-dc, 33 1-3 and 78 rpm record player and amplifier in leatherette carrying case, Emerson cabinets to fit 301 and 336 radios. Signal Radio, 2077 Coney Island Ave., Brooklyn 23, New York.

WANTED—Supreme 599 or Weston 774 or other good late model combination. Will pay your price. Also need 50L6s, pay your price. J. W. Krouse, 1787 Oakmount Road, So. Euclid 21, Ohio.

WANTED—Supreme 504A portable lab. or Hickok 510X dynamic mutual conductance tube and set tester. Must be in A-1 condition, complete. O'Brien s Radio, 609 W. 1st, Fulton, N. Y.

FOR SALE—Used tubes for all radios from when they started to make radios to 1936. Good condition and low price. Pete's Radio Shop, 405 Bridge Street, Lowell, Mass.

WANTED—Cash waiting for your Superior signal generator $15.00 for the first to reach me by express. Urgent. Notify me of your shipment in advance. Lyons Radio Service, 5706 S. Marshfield Ave., Chicago, Ill.

WANTED—Back issues, Wireless Engineer, Electrical Communications, Phillips Technical Review, Electrical Engineering, Journal I.E.E., G.E. Review. Grote Reber, 212 W. Seminary St., Wheaton, Illinois.

FOR SALE—Weston A.C. voltmeter, model 476, 0-150 v. scale. Perfect condition. Make offer. L. West, 93 Monticello Avenue, Jersey City 4, N. J.

FOR SALE—Tube tester, set tester, signal generator, Rider's Manuals, good stock of tubes and parts. Write for details M. W. Raybon, Conover, N. C.

WANTED—A grateful sailor would appreciate a copy of Mathematics for Electricians and Radiomen by Cooke, and published by McGraw Hill Co. Can you spare me one? I Henry Heyer, S1/cRT, Co. 388, U.S.N.T.C., Sampson, New York.

FOR SALE—Triumph cathode ray oscilloscope, mod. 830, 3" screen, hardly used. Carl Schradieck, 65 Hazard Avenue, Providence 6, Rhode Island.

WANTED—Good grade condenser checker. No. old timers. Quote make, model, condition and price. Martin Radio Service, 142 Ralph Ave., Brooklyn, N. Y.

FOR TRADE—Howard mod. 460 communication receiver, A-1 condition, complete with 13 tubes. preselector, loop kit, xtal, etc. Want Hickok RFO-5 scope. Earl D. Kent, Mountain Home, Idaho.

FOR SALE—Complete Hickok radio lab, A-1 shape: mod. 155 traceometer, 19X crystal control microvolt generator, RFO 5 oscilograph, 210S zero current voltmeter tester, end cols, lamps, reflectors, de luxe work bench and Rider's vols. 3 to 13 inclusive. Price $1,000.00 f.o.b. Laredo, Texas. Radio Service and Supply Co., 1219 Lincoln St., Laredo, Texas.

FOR SALE—150 new tubes at list prices, about 70 tested used tubes, many condensers, resistors, and parts. New phono motor and table $20; Burton Rogers tube tester, mod. 21, $15; VTVM $35, Supreme Diagometer 585 $80; Supreme signal generator 571 $45; Superior tester 1280 $21; output meter, 8" meter $25; 2 small radios $19 each. W. S. Crooks, Box 94, Kent, Ohio.

FOR SALE—New radio tubes in original cartons at 40% off, 10, WD-11, 12A, 31, 40, 89, X99, 1E7, 1B4. Torrence Radio, 2012 Madison Ave., Toledo 2, Ohio.

FOR SALE—3 battery sets complete with tubes and spkrs. 1 S.M. original 8-tube ac with tubes and dynamic. 1 Tungar and 1 Rectox trickle charger. Best offer for any or all. Ray Decker, 119 Pine St., Portland 4, Maine.

FOR SALE—Superior Sig. generator, model G.N.T. 6 bands from 100kc to 2200 kc and 2.2 mc to 105 kc AF and RF Audio frequency from 25 to 10,000 cycles. $35. John E. Thiel, 742 N. Denver, Tulsa 6, Okla.

WANTED—Rider Manuals 1, 2, and 6 to 13. Top prices for one or all. Also Simpson 0-1 Ma. model 27 meter scale for V.O.M. meter. John E. Thiel, 742 N. Denver, Tulsa 6, Okla.

FOR SALE—Tubes—200 in sealed cartons and 200 perfect tubes unboxed. Tubes in cartons at OPA list. Unboxed tubes 30% off. Send for what you need with check or money order. Refund on anything we have not in stock. Mason Radio, 114 E. 3 St., Mt. Vernon, N. Y.

WANTED—For Cash—Hallicrafters S-29; or any good communication receiver which has provision for 6v portable operation. All letters answered. Kenneth Walker, LaCygne, Kan.

WANTED—Riders Service Manual vol. 6. Modern Radio Servicing by Ghirardi. Servicing by Signal Tracing. Must be complete and in good condition. Clarence W. Hull, Sr., Mineral Springs, Pa.

SELL OR TRADE — Clough Brengle OCA all-wave Signal generator. Dayrad Raytheon 92 tube tester; Potter model A condenser tester; Mallory 3 amp battery charger; Race motor hair clippers, 3A folding camera. Glenn Watt, Chanute, Kans.

FOR SALE—Sun lamp; vibrators; electric belt and radios. August Engfer, 715A W. Scott St., Milwaukee, Wis.

TRADE—5" Tripplett VOM in box for sig. gen. AC or DC. Also want instruction sheet "How to Make 9 Basic Tests with Superior Channel Analyst." Need all kinds of test instr., tubes. Send prices. L. Olsen, 6017¼ Sunset Blvd., Los Angeles 28, Calif.

FOR SALE — Miscellaneous tubes and equipment. Write for list. Fred Craven, 2216 S. 7th St., Phila. 48, Pa.

FOR SALE—Radio tubes, new, postpaid 26, 27, 35, 24A, 6Y5, 6A75, 32, 37, O1A, 6Q7G, 551 and P2 types—one ea. avail. E. L. Freeland, 4832½ W. Madison, Chicago 44, Ill.

WANTED—T.R.F. Hi-Fidelity tuner, preferably Miller, in kit or assembled. Also Bogen P.V-20 amplifier and Meissner Signal splicer. State lowest price and condition. R. A. Brewer, Box 107, Franklin Village, Mich.

FOR SALE—Assorted radios and chassis. Write for list. Louis A. Goldstone, 1279 Sheridan Ave., Bronx 56, N. Y.

WANTED—Hook-up for 318-Atwater-Kent radio. Must be for this particular model. Write to Frank Johnson, 320 Orchard St., Oil City, Pa.

HELP WANTED—Excellent permanent position open as Laboratory Technician to any C-D reader, male or female offering suitable qualifications. Apply by letter only. Mr. C. T. Martowicz, c/o H. L. Crowley & Co., 1 Central Ave., West Orange, N. J.

WANTED—Good tube tester and capacitor analyzer. Price and condition in first letter Thomas L. Siglin, 427 Wayne Ave., Oakland 6, Calif.

WANTED — For cash—Hallicrafters short wave receiver. Prefer the "Sky Champ" model or what model have you. Please give details in first letter. C. N. Cheadle, 315 Y.M.C.A., 3210 Arthington St., Chicago 24, Ill.

FOR SALE OR SWAP—For what have you. 1T4, 1C6, 1A6, 19 12SN7, 22, 31, 32, 48, 49, 1J5, 12A5, 10, etc.Joseph F. Happle, 110 McGuire St., Oneida, N. Y.

FOR SALE—New G.I. Recorder—playback unit—2 speed in original carton, $45. 2v Porta-Power pack—Model L, $12. Used Western Electric oil damped pick-up mod. 4A, $8.50. Utah PM trumpet unit 25w 15ohm V.C. F.O.B. M. A. Porter, 1713 Larrabee St., Chicago 14, Ill.

FOR SALE—Astatic mike mod. J-30, $17.50 Astatic mike mod. JT-30, $15. Both new. M. A. Porter, 1713 Larrabee St., Chicago 14, Ill.

FOR SALE—Oscilloscope, Clough Brengle CRA 3", also Supreme 560A Vedolyzer. Eddie, 1724 Central, Middletown 6, Ohio.

WANTED — Test equipment, tubes and parts, for both receivers and transmitters, also electric motors. All must be new or near new condition. Courtney Radio Labs., 4522a San Francisco Ave., St. Louis 15, Mo.

WANTED — RCA, GE, DuMont or other Television sets in any condition. Electronics Service & Supply, 264 W 40th St., New York 18, N. Y.

WANTED—Air Mail stamps of any country (used). Also British Colonies (used). Send cat. No. and lowest price. Benjamin Pomerance, 2835 Bedford Ave., Brooklyn 10, N. Y.

FOR SALE—New RCA 800 tube; new RCA 814 tube; two Taylor T-55, used, but good; Eimsc 75T used. all for $25 fob. Wm. Worland, 606 Martin St., Greenville, Ohio.

WANTED — Television receiver. Prefer large screen. State make, mod. no., condition and price. Jack's Radio Service, 296 Wainwright St., Newark, N. J.

WANTED—One dozen Rola G-12 Dynamic Loudspeaker units with or without cones and transformers, but with a 1500 ohm field coil. Paul H. Thomsen, 903 Philadelphia Ave., Silver Spring, Md.

FOR SALE — Following Tubes, factory sealed: 6SA7GT, 35Z5, 50L6, 12SK7, 12SQ7, 5Y3, 25Z5, 80, 1N5, 1A5, 1H5, and others. Two to a customer. No dealers. Also 15 new five-inch PM speakers with output transformers to match. Melvin Okin, Suite 1103, 210 Fifth Ave., New York, N. Y.

FOR SALE — Postcard camera, 1 electric shaver; 3 Brunswick 9 tube chassis, 1 RCA Victor R32 chassis and power pk., 1 fan, 1 Majestic 90B chassis, 1 Majestic 90 pwr. pk., several other chassis, and speakers. All in playing order. Louis A. Goldstone, 1279 Sheridan Ave., Bronx 56, New York.

TRADE—Rider's Manuals 1 to 12 inclusive, practically new, for a Johnson outboard motor, 5 or 6 h.p., in very good condition, or will sell for $100 cash. J. P. Miller, Ashland, Nebraska.

WANTED—Good used 3" oscillograph at reasonable price. Also any good 3 tube, 3 or 4 band preselector (2 stage RF amp.) such as Howard 650, RME DB-20, or Meissner 9-1031, also RME LF-90 low frequency inverter. Michael J. Blackwell, c/o Marine Hospital, Foot California Ave., Memphis 5, Tennessee.

FOR SALE—Weston 0-1 dc milliammeter, model 301 like new. Four new RCA 954. Good used transmitting tubes, 2 RCA 865, 2 RCA 828, 5 WE 212D with 2 WE tube sockets and Stancor filament trans. 14v at 12 amps. Need 6 ft. Par-Metal relay rack No. RR195 in A-1 condition. Joseph Mackora, 63 Pratt St., East Hartford, Conn.

FOR SALE—1 each Turner Hi-impedance dynamic mikes, CD, 22D, 33D, U9S Universal; 3 2-sec. floor type mike stands; 3 -sec. floor type mike stands, 3 Utah 12P PM, 12" spkrs., 2 crystal pick-ups. All new, mikes with 25 ft. mike cable. John J. Spankowitch, 239 N. 9th Street, Allentown, Pa.

WANTED—15 to 100W amplifiers, turn tables, microphone stands, pickups and intercommunication units. Fox Radio Service, 435 So. 5th St., Richmond, Ind.

TRADE—0-1 milliammeter, Rider Manuals, test equip., tubes, radio equip., etc. WANT K&E Engineer's slide rule or equal, LC checker, Jr. v-ohmist, old watches and jewelry. Robert G. Browning, 552 Eleventh Ave., Prospect Park, Pa.

WANTED—Wireless phono oscillator, 1, 2 or 3 tube,in working order.Also 35 mm. candid camera or 127 size for cash. Have sound picture supplies; projectors, lamp houses, generators, rectifiers, sound heads. John Arnold, P. O. Box 84 Bluffs, Ill.

FOR SALE—Readrite tube tester model 430 and Ranger Examiner Signal generator model 557 with new batteries. Any reasonable offer accepted. The Modern Home appliances, 4A Mechanic St., Webster, Mass.

CASH WAITING — For your pickups or phono motor. Send description and price to Joe's Radio, 2224 W. Belden Ave., Chicago 47, Illinois.

WANTED—Receiver, such as HQ120, Hammerlund, or AR77 RCA or equivalent Robert Rath, 4835 North Kostner, Chicago 30, Ill.

FOR SALE—1941 Philco auto radio almost new, $35; 1937 Delco auto radio, good condition $20. Want Oct., Nov. 1937, and Nov., 1938, issues of Radio News. Paul Capito, 637 W. 21 St., Erie, Pa.

WANTED—Will pay top cash for Supreme 560-560A Vedolyzer and 561 audio oscillator. If you have phone include number and price in your letter. Carl Vorlicek, 3621 E. 63 St., Cleveland, Ohio

WANTED—All kinds of radio test equipment, analyzers, etc. Quote what you have to sell and lowest cost prices. National Sound Equipment Co., 625 Main St., Worcester, Mass.

WANTED—FM receiver or converter, also television receiver and late communications receiver. Will pay cash or trade lot of hard to get tubes and parts. Carl H. Stello, 925 Monroe St., N.E., Washington, D. C.

MUST SELL NOW—1 Webster 4L35 35 w. amp., 2 30 w. booster amp., Hickock output meter, 2 Cinaudagraph HWA units with SW horns, 1 University PAH unit with LH horn, 3 shielded 200 ohm to grid line trans., 2 model 55B Shure Unidyne, 1 RCA 50-A inductor mikes with floor stands, 1 Brush B1 hand mike, 1 250, 1 100, 1 75 and 2 25 ft. lengths 2 wire shielded mike cable, all with Amphenol connectors, 6 Oxford 12" dynamics with horns, all like new. John's Radio Shop, 32 Maple St., Perry, Ohio.

FOR SALE—One Unitron battery charger. Takes from 1 to 12 batteries at 15 amps. in A-1 condition. Price $50, or will swap for testing equipment such as multimeters or any useful equipment. Lovett's Radio Shop, P.O. Box 143, Newland, N. C.

FOR SALE OR TRADE — Automatic code machine, 3 955 acorn tubes, auto vibrators and transformer, 7" Triplett foundation meter, photo electric cell, with relay, chassis, etc. What have you. Joe's Radio, 2224 W. Belden Ave., Chicago 47, Illinois.

FOR SALE — Zenith deluxe trans-ocean Clipper portable radio, model 7G605, like new, extra battery. Also F 1.9 lens 50mm Gundlach-Manhattan. Best cash offer or swap for communications receiver, or what have you? J. J. Cermak, 1928 Grove, Berwyn, Ill.

FOR SALE—Back numbers of radio and mechanical mags., Radio Craft, Radio News, Short Wave Craft, Popular Mechanics, Popular Science, etc. Aubrey Edgerton, 116 W. 6th Ave., Houston 7, Texas.

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